Macintosh

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FEATURE ARTICLES

Macintosh-to-Mainframe Connectivity

SPECIAL ANNOUNCEMENTS

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Apple and the IBM Systems Application Architecture

Apple approaches communication with mainframe environments in the same spirit that characterizes its approach to the Macintosh® computer and to computer communications in general. The idea is that users should be able to work directly and intuitively with the information they need, whether it resides locally, on a network, on a departmental computer, or on a remote host. To this end, Apple's goal is to resolve differences in protocols, architectures, or interfaces in a way that is invisible to the user.

A key element of the Apple networking strategy is integration of Macintosh computers with Systems Application Architecture (SAA), IBM's networking strategy for connecting computer systems—mainframes, minicomputers, and personal computers—and the applications that run on them. Apple provides basic connectivity for the Macintosh, and furnishes developers and customers with a set of protocols, interfaces, and tools that help them develop consistent, integrated Macintosh applications for the IBM environment. Such a strategy helps to produce highly functional software in the shortest possible time by allowing developers to concentrate on the application and user interface, rather than on networking.

Apple offers a range of networking products that implement key IBM SAA Common Communications Support functions:

- The Apple® TokenTalk® NB, Serial NB, and Coax/Twinax cards provide Macintosh connections to IBM SNA (Systems Network Architecture) networks.
- MacDFT® software provides 3270 terminal emulation with file transfer, as well as the ability to copy and paste between the 3270 screens and Macintosh applications. (See "Overview: MacDFT," page 23.)
- The Apple 3270 API serves as the 3270/SNA programming interface for Apple's Data Access Language (formerly called CL/1) and MacWorkStation™ and for third-party applications. It is also available for the development of customized 3270 applications.
- MacAPPC™ implements the LU 6.2/PU 2.1 protocols, offering the basis for Macintosh integration with IBM's evolving SNA strategy for peer-to-peer, or cooperative processing, applications. MacAPPC facilitates development of commercial Macintosh applications that can dynamically exchange information with IBM host-based applications. These Macintosh applications use the full capabilities of the Macintosh as a powerful computer, not simply as a dumb terminal. (See "Overview: MacAPPC," page 25.)

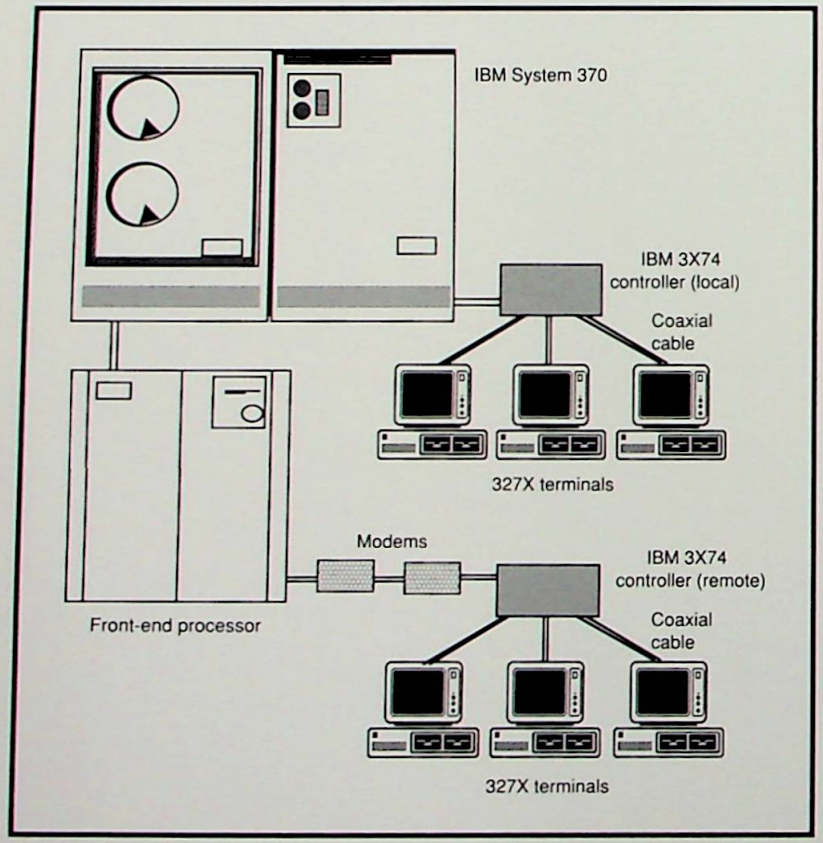
The Common Programming Interface (CPI) element of SAA contains two technologies that complement the Macintosh: SQL for the database interface and CPI-C for communications. Data Access Language (DAL) is the Apple host database access software and programming interface that provides the functionality of the CPI SQL interface. DAL provides consistent access to multiple database environments and multiple operating systems from Macintosh applications.

Because most computing environments today include systems from many different vendors, Apple's strategy is designed to make Macintosh computers excel in a multivendor environment. For example, many organizations use Digital VAX™ systems and UNIX platforms in addition to IBM systems. Apple's codevelopment agreement with Digital Equipment Corporation has produced DEC LanWORKS, a product that provides a framework for integrating the Apple and Digital computing environments. (See "Overview: DEC LanWORKS for Macintosh Computers," page 27.) And in UNIX environments, the Apple A/UX® Version 2.0 implementation of AT&T UNIX® System V runs Macintosh applications and standard UNIX applications with full communications support based on industry standards such as TCP/IP, or Transmission Control Protocol/Internet Protocol. (For more information, see "TCP/IP and MacTCP," in the July 1990 issue of the *Macintosh Technical Bulletin*.)

Unlike many vendors, whose personal computer, mainframe, and workstation user interfaces vary, Apple can provide a single user interface, a mature application base, and data interchange capability across all of these systems—advantages that can be productively applied to SAA resources, as well as to those of other environments.

Introduction to the IBM 3270 Network

IBM first introduced its System 360 mainframes in the mid-1960s. In the early 1970s those systems evolved to the System 370 mainframes in use today. With the System 370 series, IBM was the first company to offer a line of mainframes that provided compatibility between different models, as well as allowing customers to upgrade their equipment. As a result of such compatibility, networks of IBM 3270 terminals (which access the System 370 series) are among the most common computer networks in the world. With more than 20 years of investments in these systems and in related application software and training, user commitment to IBM architecture is strong.



The IBM 3270 networks were developed to allow users located away from the mainframe computer to have access to mainframe processing and applications. Though the 3270 systems have evolved, and the capabilities of the networks have increased, the basic concept of the 3270 network has remained the same.

The IBM networking model consists of a central core of computing power accessed by a large number of "dumb" terminals or personal computers emulating dumb terminals. IBM Systems Network Architecture (SNA) protocols, pacing, and routing algorithms are based on the assumption of a system in which dumb devices are in continuous connection with a central host. Consequently, most older models of the 3270 family cannot save or print, although newer models provide a printer port for local screen copy.

3270 Network Components

A 3270 network consists of five major hardware components, each with its own associated software. These components are:

- Host (mainframe computer)
- Front-end processor (telecommunications controller)
- Modems
- Cluster controllers
- Terminal devices

These components are discussed in the sections that follow.

Mainframe Computer

The heart of the 3270 system is the mainframe computer—also called the host or central processing unit (CPU). IBM based the 3270 network on a master-slave hierarchy, with the mainframe computer serving as the master. The mainframe computer—which consists of hardware and software—supplies the processing power for the network and operating system(s), and stores the applications. The operating system controls the use of the CPU resources and oversees and coordinates the execution of programs.

IBM divides its computer models into families, or series. During the late 1970s, the company introduced the 303X models, followed by the 43XX and 308X models in the early 1980s. (In these model numbers, X's represent digits. For example, the 43XX family includes such models as the 4331, 4361, and 4381.) The most recent entries in the System 370 family are the large 3090 models, sometimes called the Sierra systems, and the small 9370 midrange line. The processing power of different machines in a family may vary greatly; however, software written for one machine can be run on another machine in the same family relatively simply and cost-effectively. The host computer in a 3270 environment is generally a member of the 303X, 308X, 3090, or 43XX family.

In relationship to the 3270 network, the software on the mainframe can be divided into four types:

- Operating systems
- Application programs
- Transaction processors
- Access methods

The **operating system** is the primary software residing on the host computer; it controls the use of the CPU resources and oversees and coordinates the execution of programs. The operating system serves the same function that DOS does on a personal computer and the Macintosh operating system does on the Macintosh. Currently, three operating systems can run on the System 370 hardware:

- DOS (Disk Operating System): Not considered a strategic operating system by IBM, DOS remains popular because of its relatively low cost and its large installed base within the 43XX line of 370 processors.
- MVS (Multiple Virtual Storage): The primary operating system for large mainframes (308X, 309X), MVS is a multiuser, multitasking operating system used as the production system for most large mainframe sites. Its main strengths are in the batch- and transaction-processing environments.
- VM (Virtual Machine): The VM operating system divides the processor into several virtual machines, each under the control of a separate guest operating system. Originally developed as a migration tool, it is now supported over the entire product range.

Application programs are designed to perform a specific function for the user. Such programs may be written by the user or may be general-purpose programs, such as general ledger, database management, and spreadsheet applications.

Running beneath the operating system is a program called the **transaction processor**—also known as the terminal processor—which manages the interaction between an application program and the user. The transaction processor allows for user interaction and manages data storage and retrieval. The major transaction processors found on the System 370 are:

- CICS (Customer Information Control System)
- TSO (Time-Sharing Option)
- CMS (Conversational Monitoring System)

Occasionally people refer to the operating system by using a transaction processor name. Also, it's common to hear the terms combined (for example, VM/CMS, MVS/TSO).

The **access method** is a software package that controls the sharing of system resources by remote users and routes data between the host and various input and output devices. It also forms an interface between the mainframe and the telecommunications controller. Some common access methods are the following:

- VTAM (Virtual Telecommunications Access Method)
- BTAM (Basic Telecommunications Access Method)
- TCAM (Telecommunications Access Method)

Telecommunications Controller

The telecommunications controller—called the **front-end processor (FEP)** or simply the **front end**—is a hardware unit that attaches to the host computer and allows remote cluster controller units to communicate with the mainframe via modems. The front-end processor contains its own software, called the Network Control Program (NCP), which interacts with the access method in the host to control the data transfer through the network.

Some of the smaller systems, such as the 43XX series, do not use a separate front-end processor; the functions of the front end are handled by the mainframe. The 43XX series has a built-in front end called the integral control unit. The most common front-end processors from IBM are the 3705, 3720, 3725, and 3745.

Modems

Communications between the front-end processor and the cluster controller are accomplished over communication lines, which are usually dedicated transmission lines, although it's also possible to use standard dial-up phone lines.

Synchronous modems—either half or full duplex—are used to communicate over the communication lines between the FEP and the cluster controller. Most modems in 3270 networks support either 4800 or 9600 bits per second (bps), although speeds of up to 19,200 bps can be used.

Cluster Control Units

The cluster control unit, typically called the controller, acts as an interface and communications hub between the network and the user devices. Peripheral devices are attached to the cluster controller via coaxial cables that may be up to 5,000 feet (1,500 meters) long.

Three classes of cluster control units are used:

- Integral control units are built into the mainframe and are generally found on the 43XX series mainframes.

- Local cluster controllers, sometimes called **channel-attached controllers,** are attached by cables to the host computer. The local cluster controller is attached to the mainframe via bus and tag cables, the maximum length of which is 200 feet. The local controller does not interface with the front-end processor, nor does it use the same communications protocol as the remote cluster controller.

- Remote cluster controllers are not connected to the mainframe. They communicate with the front-end processor using synchronous modems, via telephone lines. Typically, more than one remote cluster controller will communicate with the same modem at the front-end processor; the FEP polls each controller in a predetermined order to inquire whether a control unit has any data to transmit.

The most common control units found in the 3270 network are the IBM 3276 Control Unit/Display Station and the 3274 and 3174 Control Units.

The IBM 3274 Control Unit is available in various models, some of which are used as local cluster controllers, while others are used as remote controllers. The 3276 Control Unit/Display Station can be used only as a remote control unit. The 3276 has a built-in CRT display station and may be configured to support a total of eight devices.

IBM has introduced a new series of cluster controllers for use with the 3270 network: the 3174 Control Unit. The 3174 is configured to support DFT devices (Distributed Function Terminal devices; see the next section, "Terminal Devices"). Not only does it support coaxial devices (as does the 3274/3276), but it can also interface asynchronous devices into the 3270 network and support the Token-Ring network.

Terminal Devices

Two major types of terminal devices are used on a 3270 network: Display terminals (called workstations by IBM) and printers. Both terminals and printers are attached to the ports of the cluster controller via RG-62AU coaxial cable, and can be located up to 5,000 feet (1,500 meters) from the cluster controller.

Although a number of models of IBM printers can be attached to the 3270 network, the most common printer is the 3287—a 132-column dot matrix printer that is available in two models (Model 1 and Model 2). The 3287 Model 1 prints 80 characters per second (cps), and the 3287 Model 2 prints 120 cps.

Display terminals for a 3270 network are divided into two categories: CUT (Control Unit Terminal) devices and DFT (Distributed Function Terminal) devices. CUT devices, which are the more common,

are nonintelligent (dumb) terminals, with no independent processing capabilities. The cluster controller handles the communications between the CUT device and the network, as well as decoding keystrokes, determining where to place characters on the screen, and a number of other functions.

Model	Columns	Rows	Characters
2	80	24	1,920
3	80	32	2,560
4	80	43	3,440
5	132	27	3,564

DFT devices are intelligent, having processing capabilities of their own. When used with a DFT device, the cluster controller acts primarily as a multiplexer, providing a communication link between the DFT device and the host. DFT devices have numerous functions available that are not possible with CUT terminals, including the ability to run multiple logical sessions on a terminal and the ability to support All Points Addressable (APA) graphics.

Not all cluster controllers can support DFT devices. The 3274 Control Units with Support T or D Microcode can support DFT, as can the 3174 Control Unit. Most 3274 Control Units that do not support DFT can be upgraded to support it by upgrading the microcode. In some cases, a hardware upgrade may also be necessary. The 3276 is not capable of supporting DFT devices.

The most common terminal devices used in 3270 networks are the 3278 (monochrome) and the 3279 (color) terminals. These, as well as other display terminals used in 3270 networks, are available in various models. The models of 3278 and 3279 terminals are distinguished by the number of characters that can be displayed on the screen.

Communication in a 3270 Network

The 3270 network uses two major protocols: Binary Synchronous Communications (BSC), sometimes called "bisync," and Synchronous Data Link Control (SDLC). BSC is the older of the two protocols and is being replaced by the SDLC protocol. Because of the expense of converting from BSC to SDLC, however, many users have yet to change.

There are a number of differences between BSC and SDLC. BSC is a character- or byte-oriented protocol, while SDLC is a bit-oriented protocol. BSC is a half-duplex protocol, whereas SDLC may be used in either half duplex or full duplex mode. BSC requires an acknowledgement after each block of data is transmitted; SDLC requires an acknowledgement after up to seven blocks of data have been transmitted. In addition, with SDLC the acknowledgement may be embedded in a data transmission, thereby making SDLC more efficient than BSC.

SDLC is normally used as the data link layer of the IBM Systems Network Architecture (SNA), a layered architecture that specifies how devices connect and communicate with one another. Devices are referred to as **network addressable units** (NAUs),

which have addresses that identify their routing locations in the network so that users can transmit data to one another. Network addressable units include three categories of devices: logical units, physical units, and System Services Control Points.

Other protocols, such as HDLC (High-level Data Link Control) and X.25, are also sometimes used in 3270 networks.

Logical units (LUs) provide users with access to network resources and manage the transmission of information between users of mainframes, minicomputers, and personal computers. Five types of logical units have been defined:

- LU type 1 is for application programs that communicate with workstations in an interactive, batch transfer, or distributive processing environment, using an SNA character string (SCS) or Document Content Architecture (DCA) data stream.
- LU type 2 is used to communicate with a display station in an interactive environment.
- LU type 3 is used to communicate with a printer using the SNA 3270 data stream.
- LU type 4 is for applications that communicate with data processing or word processing workstations.
- LU type 6.1 allows application subsystems to communicate with other application subsystems.
- LU type 6.2 supports sessions (two-way connections between two logical units) between two application programs.

A **physical unit** (PU) manages and monitors the resources of a physical node. Four types of physical units are used in 3270 networks:

- PU type 5 is the mainframe.
- PU type 4 is the front-end processor.
- PU type 2.1 is a controller that has the capability for peer-to-peer communications.
- PU type 2 is a controller, such as the 3174 and 3274, that can communicate only with a front-end processor.

System Service Control Points (SSCPs) reside in the host and activate, control, and deactivate network resources.

Trends

The 3270 protocols were not originally designed to handle the file transfer requirements of personal computers or to provide concurrent access to remote and local databases. Most personal computer interaction within the SNA environment has thus been limited to 3270 terminal emulation, which allows users to access host resources, but underutilizes the main strengths of the personal computer.

The inclusion of 3270 emulation in the extended version of OS/2 for the IBM PS/2 series of personal computers implies eventual replacement of the 327X family by intelligent devices, although such a phasing out will occur over an extended period.

As the personal computer replaces the 3270 device as the workstation, communications procedures and protocols between the micro and the mainframe must be streamlined to allow for more transparent interaction.

Host-based services, and enhanced access to them via improved device-interconnection capabilities, will continue to evolve as they receive increased attention from IBM and other vendors.

Meanwhile, the IBM 3270 communication networks are among the largest and most numerous data communications networks in use today. The wide variety of devices that can be used on 3270 networks, together with the numerous applications available, ensures the continuing popularity and use of 3270 systems.

Macintosh Connection to the 3270 Environment

Macintosh computers can communicate with IBM host processors by emulating the IBM 3278/9 terminal—the most widely used terminal in the IBM environment. Four connection methods are available in the IBM 327 environment:

- Coaxial connection
- Network connection using LocalTalk® Ethernet or Token-Ring
- Synchronous SNA/SDLC connection
- Asynchronous connection

The solutions described here offer examples of the various connection methods available.

Apple 3270 Information Display Systems

Apple offers a series of products that allow computers in the Macintosh II family to emulate 3270 terminals via coaxial cabling. The Apple Coax/Twinax Card, together with MacDFT and 3270 API software, allows the Macintosh II to emulate an IBM 3270 terminal, provide a platform for developing 3270 applications for the Macintosh, and transfer files.

- **MacDFT**

  MacDFT allows a Macintosh II computer to emulate the characteristics of an IBM 3270 terminal (CUT and DFT modes) attached to a host, while retaining the Macintosh user interface. MacDFT is used with the Apple Coax/Twinax, TokenTalk NB, or the Serial NB card. (For more information about MacDFT, see "Overview: MacDFT," page 23.)

- **Apple 3270 API**

  The Apple 3270 API (application programming interface) is a high-level application programming interface that allows development of customized Macintosh-to-mainframe applications. Similar to the IBM 3270 High-Level Language Application Programming Interface (HLLAPI), the 3270 API allows terminal emulators, file transfer programs, and tools such as Data Access Language (formerly called CL/1) and MacWorkStation to use 3270 services without involvement in the physical details of coaxial, Token-Ring, or serial (SNA/SDLC) connection.

- **MacWorkStation 3.1**

  MacWorkStation (MWS) Version 3.1 is a server application that runs on a Macintosh computer and provides standard Macintosh user interface, printing, and filing services to client applications running on remote computers.

  MacWorkStation consists of two components, the message protocol and the application server. The message protocols are commands and events that allow host applications to request services from the application server. The application server is located on the user's desktop and provides the full range of user interface services for the host applications. The host program can look and feel like a Macintosh application because it can control high-level user interface objects, such as windows, pull-down menus, and dialog boxes—without requiring the user to learn the details of a traditional Macintosh programming environment. Additional benefits of MacWorkStation include the reduction of time for host CPU processing,

reduced network traffic, reduced development time, and increased functionality of the host programs.

MacWorkStation is available to developers through APDA®. (For an overview of MacWorkStation, see the May 1990 issue of the *Macintosh Technical Bulletin.*)

- **Apple TokenTalk NB Card**

The Apple TokenTalk NB Card connects Macintosh II computers to Token-Ring networks. Used with appropriate software, the card supports a variety of network environments, including the AppleTalk® network system, as well as IBM 3270, APPC, and SMB networks (Server Messenger Block; PC LAN Server Version 1.2 or later, or OS/2 LAN Manager). Users can access both local area network and mainframe services connected to the Token-Ring.

The TokenTalk card is an intelligent NuBus™ interface card that has its own 68000 microprocessor, memory, and multitasking operating system. Independent of the Macintosh II computer processor, the card supports the execution of multiple networking protocols with minimal access to the main Macintosh II processor and operating system. (See illustration on opposite page.)

Users of the Apple TokenTalk NB Card can run the following communications software: TokenTalk software, together with SMB File Transfer Utility, MacAPPC Version 1.1, or MacDFT Version 1.1. (For an overview of the Apple TokenTalk NB Card, see the June 1990 issue of the *Macintosh Technical Bulletin.*)

For ordering information, contact your authorized Apple reseller or representative.

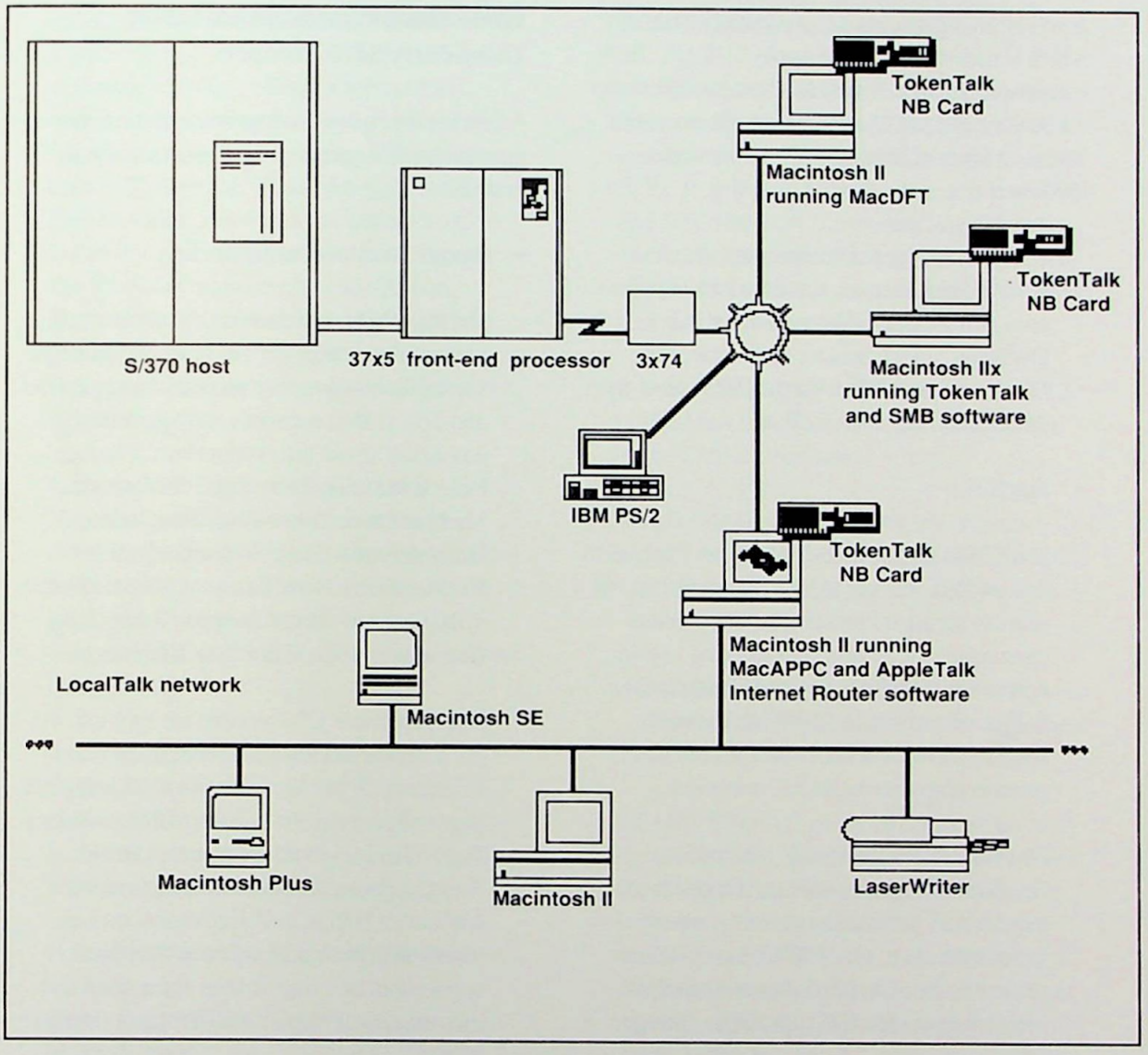
- **MacAPPC**

MacAPPC, Apple's implementation of the IBM Advanced Program to Program Communications (APPC) protocol suites, allows a Macintosh II computer to serve as a gateway between an AppleTalk network of Macintosh computers and an SNA network, providing APPC support for all the Macintosh computers on the AppleTalk network.

MacAPPC is used with the Apple Serial NB Card or the TokenTalk NB Card. The cards support the communications protocols with minimal access to the Macintosh processor and operating system. (See "Overview: MacAPPC," page 25.)

- **Data Access Language**

One of Apple's first true cooperative processing environments, Data Access Language (formerly called CL/1) is a connectivity language that gives desktop workstations high-level access to information on host data processing systems. Using Data Access Language (DAL), a desktop application can request and update host-based data in a uniform manner, independent of variations in network technology, host architecture, and database systems. The role of DAL is to insulate the desktop application from these details and differences, allowing it to provide improved interaction between personal processing on the desktop and organizational computing on the host system.



Data Access Language for MVS and VM extends the power of DAL to relational databases on IBM host systems. The MVS version of the DAL server runs in conjunction with TSO using DB2, while the VM version uses CMS and SQL/DS.

The connection between the Macintosh computer and the IBM host system can operate over several physical paths offered by many vendors; the Data Access Language Toolkit supports connection to several 3270 APIs. The Apple 3270 API is supported via the Apple Coax/Twinax Card, TokenTalk NB Card, and Serial NB Card. The Tri-Data Netway

family of SNA gateways supports the Tri-Data API, which is patterned after the Apple 3270 API. DCA uses its version of API, which is also patterned after the Apple 3270 API. Avatar uses proprietary APIs across a variety of its own 3270 attachment hardware.

For an overview of DAL and subsequent updates, including a list of third-party applications that include DAL support, see "CL/1: Overview," in the January 1990 issue, and "CL/1: Update," in the March 1990 issue of the *Macintosh Technical Bulletin.*

- **MacX25**

MacX25™ software is both a network integration tool and a developer tool. It allows Macintosh users to access information on host systems connected to X.25 networks as easily as they access local systems. As a server distributing X.25 access across an AppleTalk network, MacX25 allows Macintosh systems to be full peers in corporate backbone networks.

The MacX25 Programming Library allows developers to create distributed applications that require X.25 access. Convenient routines support access to the MacX25 server without requiring detailed knowledge of AppleTalk programming. MacX25 is available through APDA.

Third-Party 3270 Products

Following are descriptions of some of the major third-party 3270 connectivity solutions currently available.

- **Avatar MacMainFrame Series**

MacMainFrame communications products from Avatar provide IBM 3270 connectivity in single-workstation or gateway versions for coax, SDLC, and Token-Ring networks, with graphics emulation across the product line. Products include MacMainFrame SDLC Workstation, MacMainFrame Token-Ring Workstation, MacMainFrame Coax Workstation, MacMainFrame Coax Gateway, MacMainFrame SDLC Gateway, MacMainFrame Token-Ring Gateway, and MacMainFrame Graphics.

MacMainFrame 3270 services are split into the client/server model; the server can be a Macintosh SE, SE/30, or Macintosh II computer physically connected to coax, SDLC, or Token-Ring. Client application software can be MacMainFrame Workstation multisession software, a HyperCard® application such as MacPROFS, the MacMainFrame Graphics application, or a user-written application that uses the Avatar Applications Program Interface (API).

MacMainFrame Graphics is a software product that allows Macintosh users to access and manipulate host graphics locally on Macintosh computers. It emulates the IBM 3179G and

3192G color graphics terminals and uses a DFT-supported graphics method called All Points Addressable (APA). APA is a sophisticated vector description method that provides better implementation of host graphics manipulation than CUT methods. Users of any SNA version of the MacMainFrame Series, including Coax, Token-Ring, or SDLC Gateway products, can use the MacMainFrame Graphics application. Because MacMainFrame is used in a gateway configuration, sharing of host graphics sessions is supported among a large group of Macintosh workstations.

Each MacMainFrame product includes MacMainFrame user software that has been developed to provide a consistent interface and functionality across all MacMainFrame hardware platforms, whether running on coax, Token-Ring, or SDLC, and with workstation or gateway connections.

Avatar also offers the MacMainFrame Programmer's Toolkit, a set of API tools that allows developers to write front-end programs for MacMainFrame in HyperCard or any other high-level programming language.

For more information, contact Avatar as follows:

Avatar Corporation
65 South Street
Hopkinton, MA 01748
(508) 435-3000
Fax: (508) 435-2470

- **DCA MacIRMA**

MacIRMA from DCA (Digital Communications Associates) provides IBM 3278/3279 coax card terminal emulation for the Macintosh SE, SE/30, II, IIx, IIcx, IIci, and IIfx computers in both CUT and DFT modes. It allows easy access for the Macintosh computer to any mainframe application, and provides file transfer capability to three mainframe software packages:

—DCA IRMAlink, for mainframes that use DCA IRMAlink host file transfer software in TSO and CMS environments.

—DCA IRMAlink FT/3270, for mainframes that use the IBM 3270 File Transfer host software (IND$FILE) in CICS, TSO, or CMS environments.

—DCA ForteNet TSO and CMS, for mainframes that use ForteNet host software for high-speed file transfers.

DCA MacIRMA API provides compatibility with the IBM HLLAPI. File transfer calls operate with the IND$FILE host file transfer software, and language interface modules are available for THINK C and MPW® C. DCA MacIRMA API supports HyperCard and includes a HyperCard interface to PROFS. DCA also supports the Apple 3270 API.

For further information, contact DCA as follows:

Digital Communications Associates, Inc.
1000 Alderman Drive
Alpharetta, GA 30201
(404) 442-4000

- **Tri-Data Netway Gateways**

  When a number of Macintosh computers and Apple LaserWriter® printers are connected via the AppleTalk network system in a workgroup, an AppleTalk-to-IBM host gateway device can emulate an IBM cluster controller. With such an approach, any Macintosh on the AppleTalk network can establish host sessions via a shared AppleTalk network system resource. The gateway is a compatible substitute for an IBM 3274-61C control unit, operating with SNA using SDLC protocols. Rather than using coaxial cable or RS-232 serial connections, this implementation makes use of the AppleTalk network capability included in all Macintosh computers. The Netway 1000 emulates an IBM 3274 control unit to connect an AppleTalk network system to an IBM mainframe, fully emulating 3278/9 Models 2, 3, 4, and 5. Each Netway 1000 permits 16 simultaneous logical sessions to the host.

  Multiple Netway 1000 products, connected to one or more hosts, can be used on a single AppleTalk network. With the MultiZone option, the Netway gateway can be accessed across AppleTalk zones.

  The Netway 2000 also takes the place of an IBM 3174 or 3274 control unit and fully emulates IBM 3278/9 Models 2, 3, 4, and 5. It provides access to multiple IBM mainframes or multiple lines to the same mainframe. It also supports LocalTalk, Ethernet, and Token-Ring environments concurrently, with 64 simultaneous host sessions—up to six sessions on the PC, and up to eight on the Macintosh using the MultiFinder® system software.

  Tri-Data MacNetway Software provides 3270 terminal emulation in a multiwindow, multisession fashion under MultiFinder. The 3270 features include base color, Model 2 screen support, host printer emulation, light-pen support, 3270 API extended color and attributes, and two types of file transfer: proprietary and IND$FILE.

  The MultiZone option, available for the Macintosh computer and for IBM PCs and compatible computers, allows users on any AppleTalk network to gain access via a bridge to a Netway connected to a separate LocalTalk-based network system.

  Tri-Data also supports MS-DOS-compatible computers in an AppleTalk environment with its Netway 1000 or PC Netway products.

  For further information, contact Tri-Data as follows:

  Tri-Data Systems, Inc.
  3270 Scott Boulevard
  Santa Clara, CA 95054-3011
  (408) 727-3270
  AppleLink® address: D0120
  Fax: (408) 980-6565

- **Simware Mac3270**

  Simware offers a software-only 3270 communications solution that allows Macintosh users—through Mac3270's full implementation of the Macintosh interface—to access host data and applications easily across all popular emulation methods, including hardware protocol converters, coaxial boards, and Simware's asynchronous protocol conversion software.

Standardizing the user interface and file transfer across many different 3270 emulation methods and network protocols, Mac3270 is functionally equivalent to its sister product, SIMPC for IBM PCs and compatibles. The result is a common user interface to mainframe data for all Macintosh and PC computer users in an organization.

For further information, contact Simware as follows:

Simware, Inc.
20 Colonnade Road
Ottawa, Ontario
Canada K2E 7M8
(613) 727-1779

IBM 3270: Vendor Connectivity Product Overview and Related Products

Vendor Connectivity Product Overview

Support Featured	Apple MacDFT 1.1	Avatar MacMainFrame 3.0+	Tri-Data MacNetway 7.0+
Macintosh computers	Macintosh II	Macintosh II, SE/30, SE, or Plus	Macintosh II, SE/30, SE, or Plus
IBM PCs	None	Separate product line	PC AT with Windows running PC Netway 2000
Connectivity hardware	Apple Coax/Twinax (CUT and DFT) Apple TokenTalk NB Apple Serial NB (DFT only)	Avatar Coax Card (CUT, DFT), Token Ring Card (DFT), SNA/SDLC Card (DFT), MacMainFrame DX (Async Protocol Converter)	Netway 1000 and Netway 2000 remote 3X74 controllers support SNA/SCLC
Emulations	3278/9 Models 2, 3, 4, 5	3278/9 Models 2, 3, 4, 5	3278/9 Models 2, 3, 4, 5
Keyboard	87 keys mapped to 105 keys	87 keys mapped to 105 keys	87 keys mapped to 105 keys
Graphics	None	APA	APA
File transfer	IND$FILE in TSO and CMS	IND$FILE in TSO, CMS, and CICS	IND$FILE in TSO, CMS, and CICS
Printers	None	3287 LU1 and LU3 to LAN-based LaserWriter printers	3287 LU3 to LAN-based LaserWriter printers
APIs	Apple 3270 API	Avatar 3270 API, HyperCard API	Tri-Data 3270 API (Apple 3270 API) and HyperCard API
Distributed sessions over Apple network systems	None	LocalTalk, EtherTalk, and TokenTalk running MacMainFrame 3.3	LocalTalk, EtherTalk, and TokenTalk with Netway 2000

Support Featured	DCA MacIRMA Workstation	Simware Mac3270 2.0
Macintosh computers	Macintosh II, SE/30, or SE	Macintosh II, SE/30, SE, or Plus
IBM PCs	Separate product line	Separate product line
Connectivity hardware	DCA coax card (CUT and DFT) IRMAline (Asynchronous Protocol Converter)	Macintosh modem port or DCA coax card
Emulations	3278/9 Models 2, 3, 4, 5	3278/9 Models 2 ,3 ,4, 5
Keyboard	87 keys mapped to 105 keys	87 keys mapped to 105 keys
Graphics	GDDM using PCLK	None
File transfer	IND$FILE, IRMAlink, and ForteNet in TSO, CMS, CICS	Simware File Transfer in TSO, CMS, and CICS
Printers	3287 LU3 to IRMAPrint-attached printers	None
APIs	MacIRMA API and HyperCard API	MacIRMA API
Distributed sessions over Apple network systems	LocalTalk, EtherTalk, and TokenTalk from PC SNA card	None

Related Connectivity Products

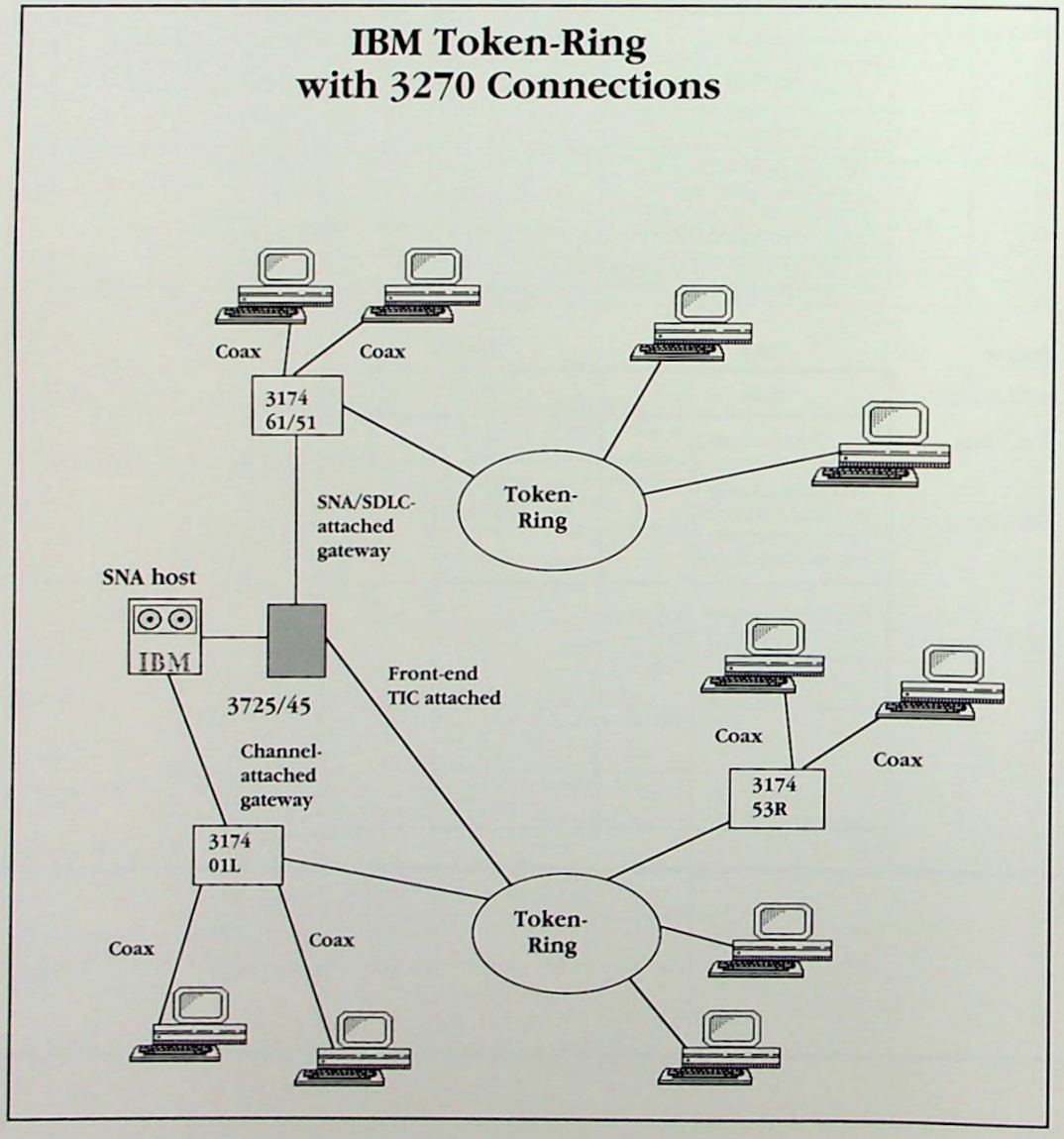
Product	Apple	Avatar	Tri-Data Systems
APPC (LU 6.2)	MacAPPC Version 1.1	None	None
Token-Ring	Apple TokenTalk NB and Apple Serial NB cards (Macintosh II)	Avatar Token Ring Card (II, SE/30, SE)	Tri-Data Token-Ring Card (Macintosh II)
DB2 and SQL/DS	Data Access Language (CL/1) supported over various hardware connectivity platforms using several APIs (Apple, Tri-Data, Avatar, MacIRMA)	Data Access Language supported over all Avatar hardware connectivity platforms using Avatar API	Data Access Language supported over all Tri-Data hardware connectivity platforms using Tri-Data API
PROFS support	MacPROFS	MacPROFS supported over all Avatar hardware connectivity platforms using Avatar API	MacPROFS supported over all Tri-Data hardware connectivity platforms using Tri-Data API
X.25 support	MacX25 supports Macintosh II, Apple Serial NB Card, and distributed sessions over Apple network systems: LocalTalk, EtherTalk, and TokenTalk	None	None

Product	DCA	Simware
APPC (LU 6.2)	None	None
Token-Ring	None for Macintosh	None
DB2 and SQL/DS	Data Access Language supported over all DCA hardware connectivity platforms using DCA API	Data Access Language supported over MacIRMA API
PROFS support	DCA PROFS application (supported over all DCA hardware connectivity platforms using DCA API) and MacPROFS	None
X.25 support	None	None

Token-Ring Connection for 3270 Devices

IBM has defined several options for connecting 3270 devices on a Token-Ring local area network to mainframe computing resources. Connection rules govern the paths that 3270 data streams can use through Token-Ring attachments.

Devices with SNA data streams on the 3270 network must be PU type 2. (For definitions of logical units [LUs] and physical units [PUs], see "Introduction to the IBM 3270 Network," page 4.) IBM 3174 controllers equipped with Token-Ring adapter cards—such as models 53R and 3R—connect coax terminals and PCs to the Token-Ring network. These controllers pass an SNA data stream to the ring that must then be processed either by a 3174 with gateway feature or by a Token-Ring Interface Coupler (TIC) on a front-end processor. (See figure below.)



Channel-Attached Gateway

The most common hardware for a gateway connection is the 3174 model 01L, which is channel-attached to the host and acts a "funnel" for all host-bound SNA data streams from "downstream PUs." In a gateway connection scenario, the model 53R or model 3R controllers represent downstream PUs. In addition to functioning as a gateway, the model 01L 3174 manages its own coax-attached terminals and PCs. A channel address is required for the 01L, with subchannel address definitions for the downstream 3174 model 53R or model 3R. Users connected by coax to a 3174 model 53R or model 3R experience very fast response times, because they are effectively connected to a channel-attached controller through a Token-Ring LAN operating at 4 megabits per second.

SNA/SDLC-Attached Gateway

The other type of gateway-equipped 3174 controller is the model 61/51, which has an SNA output via a synchronous RS-232C port. Model 61/51 controllers attach to front-end processor ports; they come with an optional Token-Ring adapter card and can be equipped with gateway software that allows SNA data streams from downstream PUs to funnel through the model 61/51 to the SNA data stream to the front end. This connection requires the front-end port to be configured for leased lines with multipoint addressing; it must be configured in the NCP (Network Control Program) with the control unit (CU) addresses for the 61/51, as well as for all downstream model 53R or model 3R 3174 controllers that are customized to pass SNA data to the gateway. The connection cannot be made directly with dial-up front-end ports because of the requirement for more than one CU address configured in NCP ("genned") to the front-end port. With this type of attachment, terminal users experience response times limited by the bit speed of the synchronous port.

Front-end TIC Attachment

The Token-Ring network can also be attached directly to the front-end processor using Token-Ring Interface Couplers (TICs). A connection like this bypasses the need for a 3174 controller with a gateway feature, because the SNA data streams from the controllers are passed directly to the front-end through the TIC. Though the necessary NCP parameters are extensive, and several modifications must be made to accommodate the Token-Ring connection, this type of connection effectively provides terminal users with channel-attached controller response times.

Connection Rules

The following rules govern connection of 3270 data stream paths through Token-Ring attachments.

- Token-Ring 3270 device connections are PU type 2.0 only.
- When TICs are used, paths must be configured in NCP configurations ("sys gens").
- When 3174 controllers with gateway capabilities are used, paths must be configured in gateway feature customization.

- Connection paths are not dynamically altered based on data load or congestion.

- Users cannot alter connection paths.

- Connection paths always include the mainframe: A 3270 terminal device cannot talk directly to another 3270 device on a different 3174 controller directly across the ring; this would be a PU 2.1 (APPC) connection.

Overview: MacDFT

Most IBM terminals and intelligent workstations are used in a Control Unit Terminal (CUT) mode of operation (see "Introduction to the IBM 3270 Network," page 4). In the CUT mode, the cluster controller provides nearly all of the communications processing for the terminal devices, effectively making the CUT device an input/output extension of the controller itself. As a result, CUT devices are often called "dumb," and a CUT terminal can provide only a single session.

Other terminals are called Distributed Function Terminal (DFT) devices, and differ from CUT devices in that most of the terminal and communications processing is performed by the terminal device, rather than by the control unit, and DFT devices can provide multiple (one to five) sessions.

With DFT devices, relatively little processing is performed by the controller—mostly basic communication error detection and handling. The control unit becomes little more than a communications switch that routes circuit connections. Cluster controller units that support DFT devices are capable of supporting CUT devices concurrently.

Apple's MacDFT is a full-function 3270 terminal emulation program that allows computers in the Macintosh II family to communicate with IBM mainframes, providing both single-session CUT or up to five-session DFT emulation of IBM 3270 terminals.

A Macintosh computer running MacDFT can access information on the IBM host while retaining the Macintosh interface, including pull-down menus and windows. MacDFT allows you to easily copy and paste text and tabular information between applications on the host and those on the Macintosh computer.

MacDFT supports keyboard remapping, so you can assign function keys—programmable application (PA) and programmable function (PF) keys—to the Macintosh keyboard, and use a pull-down menu to access stored keystrokes. MacDFT also allows you to define macros.

MacDFT Version 1.0 supports single-session CUT mode emulation over the Apple Coax/Twinax Card, which requires a coaxial connection to either a 3174 or a 3274 cluster controller. No longer available, the MacDFT Version 1.0 package included an order card that allowed users to upgrade to Version 1.1 at no charge. Version 1.1 supports single-session CUT mode emulation or up to five-session DFT mode emulation. Both CUT and DFT sessions are available with the Coax/Twinax Card. (DFT emulation is provided through the Apple TokenTalk NB Card or the Apple Serial NB Card.)

MacDFT emulates the following IBM display terminals:

Terminal Type	Model Numbers
3278 Monochrome	2, 3, 4, 5
3279 Model 2 or 3	S2A, S2B, S3A, S3B
3178 Monochrome	C3
3179 Model 1, seven-color	2

File Transfer Capabilities

MacDFT transfers files between the Macintosh II family of computers and an IBM host running either the MVS/TSO or VM/CMS operating system using

IND$FILE software (the IBM standard host file transfer software) in text, binary, and MacBinary file transfer modes. MacDFT does not support file transfer on an IBM host running CICS.

On the IBM host, you must have one of the following IBM file transfer software products installed:

- MVS 5665-311, Version 1.00 for MVS/TSO
- VM/SP 5664-281, Version 1.00 for VM/CMS

Printing

Local copy printing, as defined in the IBM 3270 environment, means printing what is on your screen to a 3287 printer connected to a control unit. Host local copy printing means printing a host file on a 3287 printer connected to the terminal. MacDFT doesn't provide 3287 emulation or support for local or host local copy printing; nor can you use your Apple printer for host-initiated printing. However, you can print documents and files produced during your MacDFT session on an Apple printer connected to your Macintosh. You can print host-resident documents to an IBM printer connected to your control unit or host, using the print commands supported in your IBM environment.

NetView

MacDFT Version 1.1 provides SNA Communications Network Management (CNM) and, specifically, NetView support, which allows MacDFT to report the appropriate network alerts. (NetView is a network management application program running on IBM 370 systems; it's used to control and manage a network, monitor its components, and diagnose its problems.)

Customization Options

MacDFT operates in either monochrome or color mode, depending on the type of monitor used and whether the controller supports color. If you use a color monitor, you have the option of using either basic four-color or extended seven-color operation, and you can choose colors from the Apple color wheel for the background and the status line.

MacDFT allows you to use a password as a security lock mechanism similar to the lock and key on a 3278 terminal. The lock prevents users who don't know your password from using MacDFT on your Macintosh, without preventing them from using the Macintosh for other operations.

MacDFT allows you to select an underline cursor or a block cursor, to have the cursor blink (or not) during operation, and to show the row/column position of the cursor in the status line.

To order MacDFT and the Apple Coax/Twinax Card, contact your authorized Apple reseller or Apple representative.

Overview: MacAPPC

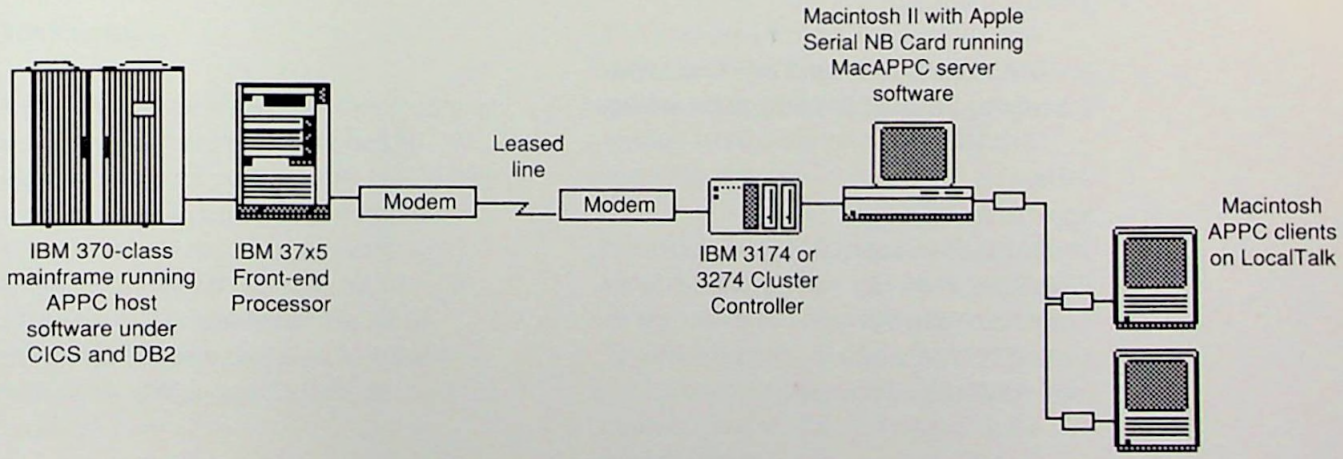
MacAPPC is Apple's implementation of the IBM LU 6.2/PU 2.1 peer-to-peer (intelligent device to intelligent device) communications protocol suites, commonly called Advanced Program to Program Communications (APPC). A central theme of SAA, LU 6.2 represents IBM's strategic direction for distributed processing products, and is becoming a widespread user requirement. APPC allows programs on different intelligent devices to communicate with each other as peers, instead of through the master-slave design of the traditional SNA environment.

With 45 of the 47 defined APPC verbs, MacAPPC is a complete LU 6.2 implementation, allowing development of commercial applications that provide access to other Macintosh and non-Macintosh computer environments using the services of LU 6.2 protocols. It is a modular extension to the Macintosh system software, ensuring availability on all members of the Macintosh family, as well as compatibility with other networks (such as the AppleTalk network system) and software that may already be installed.

In addition to interfaces for MPW C and Pascal (supplied with MPW), MacAPPC includes a HyperCard APPC stack, which extends the HyperTalk® scripting language to include the APPC verb set.

MacAPPC Environment

With MacAPPC and the Apple Serial NB Card or the Apple TokenTalk NB Card, a Macintosh II becomes a gateway between an AppleTalk network of Macintosh computers and an SNA network. Installation of the communications coprocessor board and the appropriate communications links a Macintosh II to an SNA network, creating the MacAPPC server. Subsequent connection of the Macintosh II into an AppleTalk network provides APPC support to the other Macintosh computers on the network. Because the server implementation distributes sessions over the AppleTalk network system for the client computers, even Macintosh Plus and SE systems can participate in the APPC environment.



MacAPPC is implemented through a real-time multitasking operating system on the Apple Serial NB and TokenTalk NB Cards. Both cards have the 68000 microprocessor, which operates independently of the main Macintosh II computer processor, supporting the execution of communications protocols with minimal access to the Macintosh processor and operating system.

The Serial NB Card has four serial ports, two of which can send and receive at 64K per second. The TokenTalk NB Card provides connectivity to the IBM Token-Ring LAN. Because most of the processing for MacAPPC runs on the card, a Macintosh II server is free to operate as a regular workstation while supporting direct client connections via the AppleTalk network system.

MacAPPC Setup

To use MacAPPC, you will need a Macintosh II with at least 2 megabytes of memory and configured as a server, and an Apple Serial NB Card or an Apple TokenTalk NB Card.

MacAPPC is available to developers from APDA. For ordering information, contact APDA as follows:

APDA
Apple Computer, Inc.
20525 Mariani Avenue, M/S 33G
Cupertino, CA 95014
1-800-282-2732 (U.S.)
1-800-637-0029 (Canada)
(408) 562-3910 (other countries)
AppleLink: APDA
CompuServe: 76666,2405
MCI: Postrom
GEnie: A.DEVELOPER3
MacNet: APDA
Fax: (408) 562-3971

To order the Apple Serial NB Card or TokenTalk NB Card, contact your authorized Apple reseller or Apple representative.

Overview: DEC LanWORKS for Macintosh

DEC LanWORKS, the result of a joint development agreement between Digital Equipment Corporation and Apple, is a tightly integrated Apple/Digital network environment with associated support and services. Designed as an integral part of Digital's Network Applications Support (NAS), DEC LanWORKS software enables Macintosh computers and AppleTalk networks to work with Digital VAX systems and DECnet/OSI networks.

DEC LanWORKS software for Macintosh computers offers a standard framework for connecting Macintosh and VAX computers. With LanWORKS software for Macintosh, network managers can use VAX computers as servers to Macintosh clients in local area networks, let Macintosh computers tie directly into DECnet networks, or use DECnet wide area networks to join a number of separate AppleTalk local area networks.

DEC LanWORKS software for Macintosh computers is an integrated set of components in a single software product. It includes the following networking capabilities:

- **File sharing**

  With VAXshare file services, Macintosh files are stored on VAX systems and accessed by multiple Macintosh users as easily as if the files were stored on a Macintosh. Because the VMS-based file service complies with the Apple Filing Protocol (AFP 2.0), VAXshare is as familiar as the AppleShare® File Server software, while providing Macintosh users with access to high-capacity disks and operator backups.

  With a VAX as a file server, VMS and Macintosh users and applications can share the same files and folders (directories). With Digital's DEC LanWORKS software for VMS software running on the same server as VAXshare software, VMS, Macintosh, MS-DOS, and OS/2 users and applications can share the same directories and files.

  When Macintosh files are stored on a VAX server, they gain the security and data integrity afforded by the VMS operating system. Macintosh users gain access to VAXshare by selecting an AppleShare server with the Chooser and logging in with a user name and password, which can be the same as those of the user's VMS account. VAXshare file service supports VMS Access Control Lists, giving the VMS system manager the ability to determine, on a user-by-user basis, who has access to a particular file or directory. The system manager also determines the type of access that person receives.

- **Printing services**

  VAXshare print services let Macintosh users share Digital PostScript® printers networked to systems running the VMS operating system, as well as LaserWriter printers connected to AppleTalk networks.

  Macintosh users and applications select and spool to Digital printers in the same way they choose LaserWriter printers connected to an AppleTalk network. Digital printers connected to a VAX system appear on the Macintosh Chooser menu as additional printers on the AppleTalk network.

VAXshare print services use standard VMS print queues for LaserWriter printers, Digital PrintServer printers, and ScriptPrinter printers. You can set up queues to take full advantage of advanced PrintServer features such as paper tray selection, double-sided printing, sorting, and collating. VAX users, as well as DOS and OS/2 users running DEC LanWORKS software for VMS software, can also share the same LaserWriter printers.

- **Database access**

  Macintosh applications can use either Apple's Data Access Language or Digital's NAS services implemented by SQL/Services (included with the Rdb/VMS product) to access and manipulate data from Rdb/VMS relational databases.

- **Electronic mail**

  DEC LanWORKS software for Macintosh computers provides an ALL-IN-1 MAIL client as the implementation of NAS messaging services and PCMAIL for Macintosh users.

  ALL-IN-1 MAIL for Macintosh provides sophisticated electronic-mail capabilities, such as store-and-forward services, binary attachments, and message delivery notifications, as well as data about the message and the user. It also implements all the mandatory services defined by the 1984 CCITT X.400 "P2" user agent recommendations.

  PCMAIL provides all the functionality accessible in the VMSmail utility. PCMAIL for Macintosh allows Macintosh users to read newly received mail, review previously received mail, send a Macintosh text file, and compose and edit mail to be sent. Macintosh users can send not only to other Macintosh users, but also to VMS users and PC users running PCMAIL for DOS or OS/2.

- **Access to applications**

  Application access services allow Macintosh computers to use terminal-based and DECwindows applications. With Apple MacTerminal® software, the Macintosh can act as a VT320-style terminal to any host computer on the DECnet network, bringing the applications on the network directly to the user. By utilizing the Digital LAT Tool in the Macintosh Communications Toolbox, MacTerminal allows multiple, high-speed terminal sessions over Ethernet. The LAT Tool implements Digital's LAT technology, an efficient protocol for local terminal emulations. MacTerminal provides terminal emulation over LocalTalk and wide area networks with the CTERM Tool.

  The Macintosh X Window server, Apple's MacX™ software, allows Macintosh users to display DECwindows applications running remotely on VAX systems. MacX supports monochrome and 8-bit color X client applications and supplies a variety of fonts, including special DECwindows fonts.

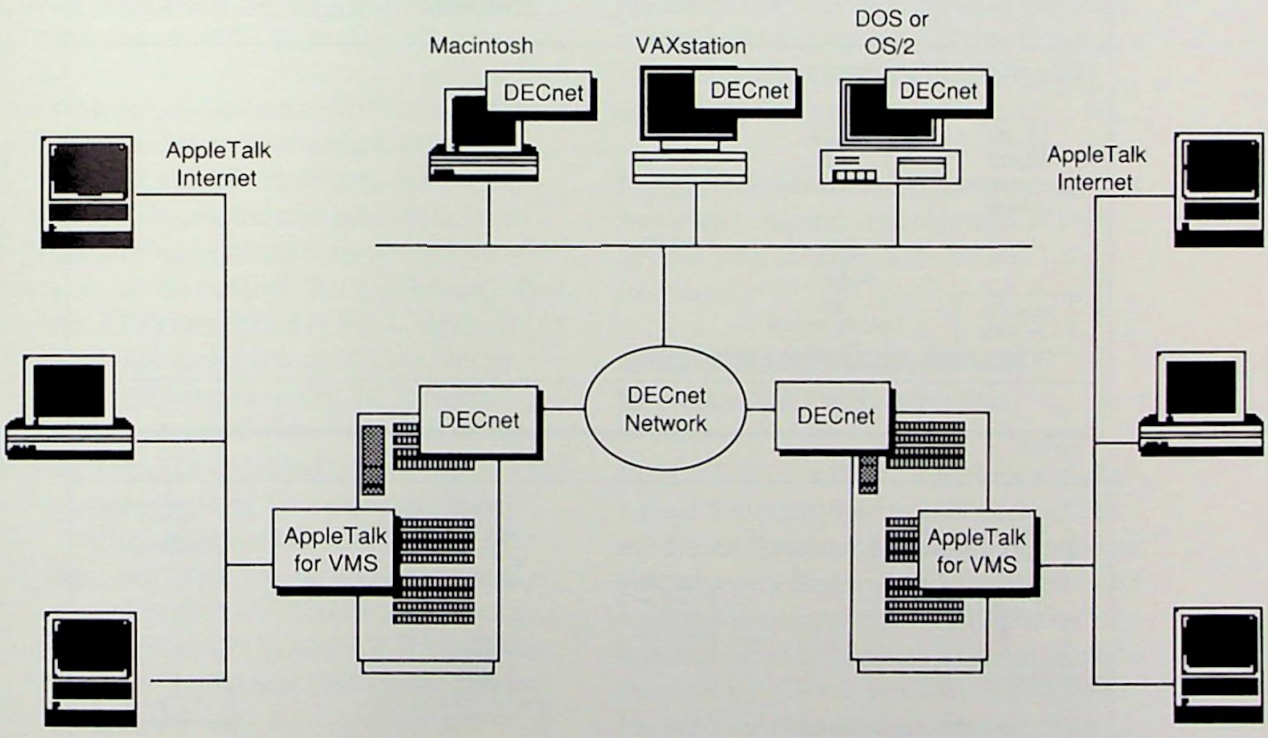
  MacX gives users a choice of interface: It can be used either as a full-screen DECwindows window or as part of the standard Macintosh desktop environment. Users can cut and paste information between DECwindows applications and Macintosh applications and even VMS applications running in a MacTerminal window. (For an overview of the X Window System and MacX, see the May 1990 issue of the *Macintosh Technical Bulletin.*)

- **Network connectivity**

  The basic connectivity features of DEC LanWORKs for Macintosh are the following:

  —AppleTalk for VMS Version 3.0. An implementation of AppleTalk Phase 2 networking protocols and interface libraries for VMS systems, AppleTalk for VMS enables routing, or "tunneling," through DECnet, whereby AppleTalk is encapsulated in DECnet so Macintosh users can "see" across DECnet wide area networks to access remote AppleTalk networks and AFP file servers as if they were local.

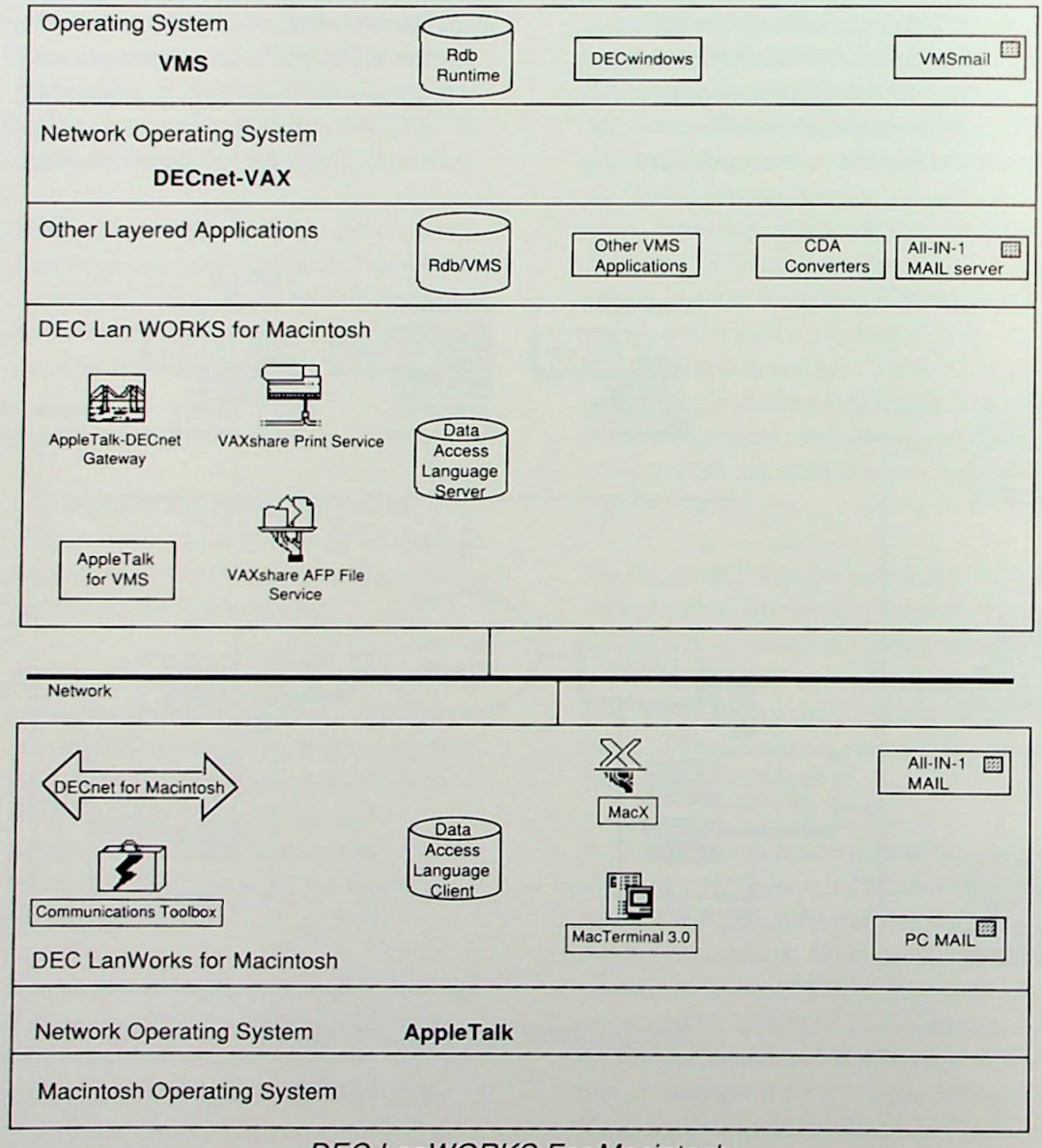
  —DECnet for Macintosh. Permitting the Macintosh to participate as a full DECnet Phase IV nonrouting end node, DECnet for Macintosh allows direct connections to be made from the Macintosh DECnet applications and services on any DECnet node, including VMS, ULTRIX, OS/2, and DOS systems, without having to be routed first to the VAX server.



Apple-Digital Network Connectivity

DECnet is the collective name for Digital's software and hardware communications products that implement the Digital Network Architecture (DNA) protocols. With DECnet, Macintosh users and applications can do the following:

- Start remote processes anywhere on the network.
- Copy files to and from Macintosh computers and other systems running DECnet across the wide area network.



DEC LanWORKS For Macintosh

- Use distributed applications that require wide area task-to-task communications with minimal overhead.

- Participate in Digital's network management facilities.

- Directly access Digital's SQL/Services, VTX information bases, VAX Notes conference, and other DECnet-based products.

Because DECnet for Macintosh is implemented as a transport tool for the Macintosh Communications Toolbox, Macintosh applications written to the Communications Toolbox will work transparently with DECnet.

—Macintosh Communications Toolbox. The Apple Macintosh Communications Toolbox, included with DEC LanWORKS software for Macintosh, provides tools used by Macintosh applications for connections, terminal emulation, and file transfers. These tools include the AppleTalk Data Stream Protocol (ADSP) Tool for AppleTalk connection, the DECnet Tool for direct DECnet connections, the Transport Gateway Access Tool for connection through the AppleTalk-to-DECnet Gateway, an asynchronous tool for serial line connection, the LAT Tool for high-speed Ethernet connections to a host, the CTERM Tool for wide area terminal emulation, the VT320 Tool for terminal emulation, the MacTCP® Tool for TCP/IP, the Modem Tool, the Text Transfer Tool, and the XModem File Transfer Tool.

The MacX, MacTerminal, PCMAIL, and ALL-IN-1 MAIL applications are implemented via the Macintosh Communications Toolbox. MacX can make network connections to DECwindows via the ADSP Tool, the Transport Gateway Access Tool, the DECnet Tool, and the MacTCP Tool. PCMAIL and ALL-IN-1 MAIL can make network connections to their respective mail servers through the AppleTalk-to-DECnet Transport Gateway or directly through DECnet.

Network Connectivity

To connect Macintosh and VAX systems in the same network, you can connect a Macintosh directly to Ethernet by using an Ethernet card, such as the Apple EtherTalk® NB Card. Or you can use a router such as the Kinetics FastPath 4 gateway to connect a LocalTalk network of Macintosh computers to Ethernet.

DEC LanWORKS software for Macintosh works over a wide range of communications media, including Ethernet 802.3, LocalTalk, and serial lines for modems.

Interoperability with Other PCs

DEC LanWORKS for Macintosh implements Digital's Personal Computing Systems Architecture (PCSA) and delivers Network Applications Support services. PCSA provides a framework for integrating personal computers so that users can share information, large-system resources, and network services across the entire system. Network Application Support offers Macintosh and other desktop users common access to services located anywhere on the wide area network without changing the desktop environment to which they are accustomed.

PCSA is a key underpinning for Network Application Support, and the resulting structure allows Macintosh users to easily share files and printers with DOS and OS/2 users. They can also share DECwindows applications and exchange mail messages. For system managers, this means that the same server system that integrates Macintosh users into the network can also serve DOS and OS/2 users and video terminals.

LanWORKS and Network Application Support

Network Application Support is a comprehensive set of software that enables applications integration across a distributed multivendor environment. DEC LanWORKS software for Macintosh makes application development easier through the use of NAS services, open interfaces, and development tools that allow faster prototyping and ensure compatibility.

Developers can write applications that transparently access VMS databases by incorporating Data Access Language or SQL/Services support through the callable application programming interface (API).

Developers can use the DECwindows toolkit to build applications that run heavy processing portions on VAX systems, and they can use MacX for "friendly" user-interface functions. With the Macintosh Communications Toolbox, developers can build applications independent of the network transport, letting the transport provide the connectivity. Any applications developer can build a terminal emulator or other Macintosh application that uses the LAT protocol.

Digital Service and Support for Macintosh Users

Digital provides worldwide service and support for the DEC LanWORKS for Macintosh product. Digital is also an authorized Apple service provider for Digital accounts in the United States.

DEC LanWORKS supports the Macintosh Plus, SE, and SE/30, and the Macintosh II family of computers. Digital recommends a Macintosh with 2 megabytes of RAM or more.

For further information, contact your local Digital sales representative. Or, in the United States, call the Technical Consulting Center, at 1-800-343-4040, for presales assistance.

Macintosh-to-Mainframe Connectivity: Q&A

Q: I have a problem with setting MacDFT Version 1.1 for Non-SNA. I'm using the Coax/Twinax Card and a 3274 cluster controller model 61C (configured for DFT), connecting through a modem to an IBM host. When I try to configure MacDFT for Non-SNA, an error window opens and tells me to reconfigure MacDFT to SNA mode because Non-SNA is not a valid configuration. When I then set MacDFT for SNA, a similar error message tells me to configure MacDFT to Non-SNA. What's going on?

A: Your cluster controller must be configured for bisynchronous communications. MacDFT can provide only CUT support over bisynchronous communications; switching the coax CDEV setting to CUT mode should solve the problem. The purpose of the DFT Non-SNA setting is to support non-SNA channel-attached controllers, such as the 3174 01L model. Because your 61C is designed for remote connections, it isn't prepared to handle channel protocols, and MacDFT notifies you of the conflict.

Q: I thought that MacDFT 1.1 (running over Token-Ring) communicated only with a 37X5 front end with a TIC, or with a 3174 with a Token-Ring Interface. Recently I was able to log on to a mainframe through a PS/2 running the IBM Personal Communication 3270 Gateway Program. Is this a new feature of MacDFT 1.1? If the connection is supported, how can I get multiple sessions? I was able to get only one session.

A: There are two versions of the IBM 3270 gateway program for Token-Ring: one for MS-DOS and one for OS/2. The MS-DOS version uses NetBIOS; MacDFT cannot communicate with it. The OS/2 version does not use NetBIOS, and MacDFT Version 1.1 can communicate with it over Token-Ring. The reason you could open only one session is probably that the gateway program was set to support only one session per connection.

Q: IBM has an SDLC card that distributes 3270 sessions over Token-Ring. Is there software for the Macintosh that allows the Macintosh to get a session from the SDLC card over Token-Ring? If so, can the Macintosh be bridged to Ethernet or LocalTalk to get a session through that topology?

A: There is currently no software available that allows a Macintosh to connect to a distributed-session controller, such as a PC with an SDLC card. The only solution is to use a 3174 controller and appropriate software (MacDFT, or a comparable third-party product) with a Token-Ring card.

Q: I want to connect a Macintosh to a 3274-51C cluster controller. The cluster controller has four types of configuration: A, B, C, and D. Configuration support A–C is available; extended memory is needed for D. Can I connect the Macintosh to the 3274-51C setup with configuration support A, B, or C? Will MacDFT run this way?

A: MacDFT will run in cluster controller configuration support A through D; however, configurations A through C support CUT mode. Only configuration D supports DFT mode. Most 3274 control units are capable of supporting DFT devices. Generally, the hardware does not determine whether a control unit can support DFT. Rather, the control unit's microcode software supplies the additional functionality necessary to support DFT. Note, however, that there are minimum memory requirements for DFT support. In some cases, 3274 control units may require memory upgrades to support DFT.

Assuming you have enough memory, MacDFT will run in DFT mode in the D configuration if the controller microcode is 65 or higher. In remote bisynchronous communications, you can run MacDFT only in CUT mode.

Q: In color or extended color mode displaying yellow text on any color background in blinking mode, the text stays on, and the background blinks from black to white. On a regular terminal, the yellow text blinks on and off. What's wrong?

A: Macintosh QuickDraw™ routines do not support blinking characters. The reversal of background is a trade-off made to ensure better data rates across the 3270 API.

Q: I need a terminal emulator for 5250 emulation (System 36/38 or AS/400) over a Token-Ring connection. Is there something available for the Macintosh?

A: Hardware and software products from KMW, Emerald Technologies, and IDEAssociates provide such terminal emulation only over twinax cabling. Currently, there is no Macintosh solution for 5250 emulation over a Token-Ring connection.

Q: I want to allow employees to dial into the company mail system from Macintosh SE computers at home. They need to emulate a 3278 and run SDLC at 2400 baud. Can you suggest a good solution?

A: Here are a few suggestions:

- MacMainFrame DX from Avatar allows the option of remote connectivity over asynchronous modems.
- Users could run IBM 3278 emulation using MacTerminal on the Macintosh, and dial into DCA IRMALine, using a pair of Hayes-compatible asynchronous modems. IRMALine is then connected to a cluster controller via coax. The cluster controller connects to the front-end processor using synchronous modems.
- Simware's Mac3270 supports remote mainframe access via asynchronous modems. Sim3278 software must be installed on the host.

Q: Document mode enables the IBM Entry Assist function—a feature that works with several IBM host editors to provide limited local formatting, entry, and edit control. The key sequence that initiates the feature on a 3278 terminal is "Alt-Blank." On the MacDFT keyboard layout, the sequence is "Alt-CR POS." I need to know whether we can initiate the Entry Assist function with MacDFT. The key sequence above doesn't

access Document mode. (I have seen this function implemented on a PS/2 Model 60 using IRMA DFT.)

A: MacDFT Version 1.1 does not support the IBM Entry Assist function. If you need this functionality, it's provided by the DCA MacIRMA product.

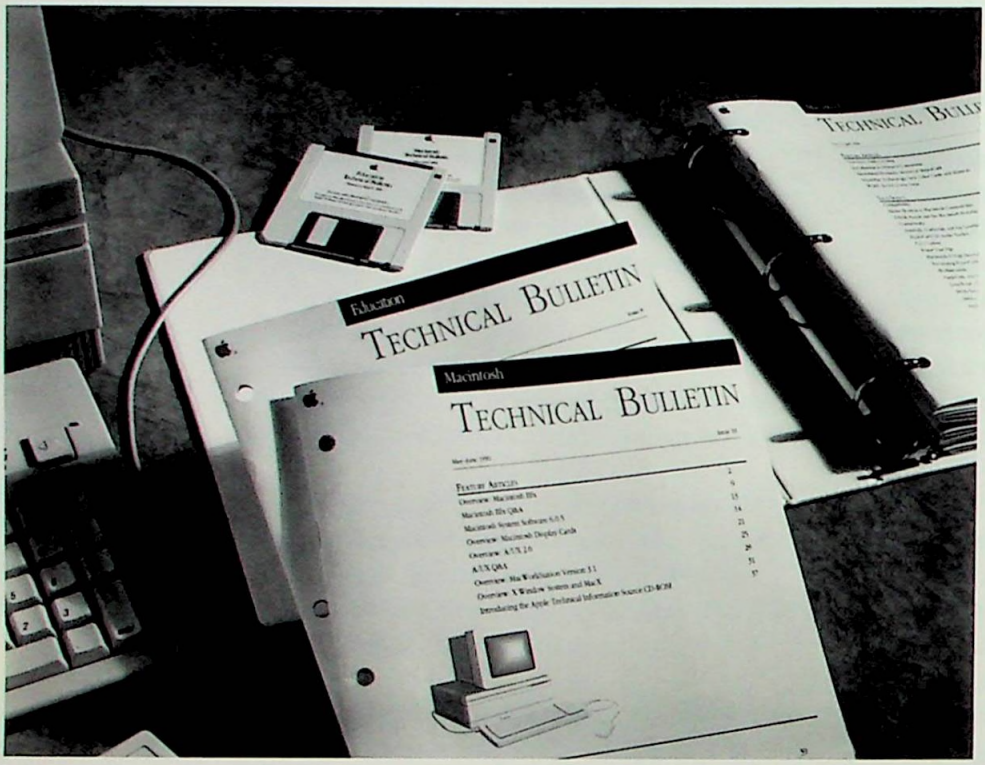
Q: I need to integrate Macintosh computers with a Cray computer. Can you tell me what hardware, software, and networking solutions Apple uses to integrate Macintosh computers to the Cray?

A: Following is the method Apple uses to connect Macintosh computers to the Cray supercomputer at its corporate headquarters: Connect Macintosh computers, running PacerLink communications software from Pacer Software, to AppleTalk. PacerLink emulates an enhanced VT100 terminal with soft keys, programmable for macros. The protocol is AppleTalk, targeted directly at the next link in the connection, the Kinetics FastPath, which then connects to Ethernet.

The FastPath strips off the AppleTalk protocol and rewraps the data in TCP/IP, which then becomes the operative protocol. Ethernet connects to a VAX 780, a VAX 785, and a Sun 2/170, and these front-end processors become gateways for the Cray. The VAX computers run Digital's implementation of UNIX, called ULTRIX, which is based on Berkeley 4.2 extensions. This 50MB channel connects to the input/output structure (I/OS) of the Cray. The I/OS goes directly to the Cray itself. The Cray software is UNICOS, Cray's version of UNIX System 5.2.

Other software is used when graphics are required. The National Center for Supercomputer Applications, in conjunction with the University of Illinois, has a package that emulates a Tektronix 4011 terminal. This software allows multiwindowing and supports Tektronix graphics, as well as doing simple UNIX file transfers.

Apple Announces Technical Bulletin Changes



Beginning with the September–October 1990 issue, the *Apple II Technical Bulletin* becomes the *Education Technical Bulletin,* to better meet the information and support needs of its audience, virtually all of whom are Apple K–12 education customers. The *Education Technical Bulletin* will cover both Apple II and Macintosh solutions for the K–12 marketplace. The *Apple II Technical Bulletin* will no longer be available.

Apple is also enhancing the Technical Bulletin product line: Current and new subscribers will receive a HyperCard stack containing all the back issues of the version of the Technical Bulletin to which they subscribe, starting with the first issue of the publication in 1988.

With this issue, current subscribers of *Macintosh Technical Bulletin* have received an additional disk, which contains a stack of the articles from 1988 and 1989; subscribers to the *Education Technical Bulletin* will receive the Apple II version of this disk in the October–November issue. New subscribers will receive the disk as part of the starter kit. The complete set of articles from 1990 will be included with either the January–February *Macintosh Technical Bulletin* or the February–March *Education Technical Bulletin.*

For more information about the *Education Technical Bulletin,* please contact your Apple representative or authorized Apple reseller.

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Managing Editor: Armi Costello
Technical Editor: Shelley Bowers
Writer: Jennifer Woodul
Editor: Teri Thomas
Copy Editor: Van Goode
Production Manager: Susan Moore
Contributors: Alex Gernert, Jennifer Minge,
Glenn Onufer

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If you have any comments or suggestions, please contact:

Technical Bulletins
Apple Computer, Inc.
900 East Hamilton Avenue, M/S 72L
Campbell, CA 95008
AppleLink: TECHBULLETIN

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Apple Computer, Inc.
20525 Mariani Avenue
Cupertino, California 95014
(408) 996-1010
TLX 171-576